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Fatty Acid Metabolism in the Synovial Fluid in the Patients with Rheumatoid Arthritis and Osteoarthritis

by

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INTRODUCTION

Rheumatoid arthritis and osteoarthritis are typical diseases of the joint which have been studied contrastively with respect to etiology, course and prognosis.

The specificity of the biochemical finding in the synovial fluid of the rheumatoid arthritis suggests that the latter is not only a morbus sui generis but a variation of metabolism in the whole body disease which is accompanied with metabolism disorder such as hypofunction of the liver and adrenals either latent or manifest. These explanations have been recently supported by many authors.

From this point of view, the authors attempted to investigate the changes of fatty acid fraction in the synovial fluid of the patient with rheumatoid arthritis and osteoarthritis by means of gaschromatographic analysis.

MATERIALS AND METHODS

The fatty acid fractions were determined in 30 specimens obtained from 11 patients of rheumatoid arthritis and 25 specimens in 18 patients of osteoarthritis.

Fatty acid fractions of the plasma in the same subjects were determined simultaneously in order to compare them with those of synovial fluid.

Furthermore, synovial fluids in the right and left side were collected simultaneously to investigate the difference of fatty acid fraction in both sides. All of the specimens were obtained from fasting patients.

Fatty acid in the synovial fluid was extracted according to Folch. It was, then, methylesterified and fractionated by gaschromatography (YANAGIMOTO, GCG-3D Type). The percent distribution was obtained by measuring the peak width at half the maximum height.

RESULTS

- 1) Comparison of fatty acid fraction in the synovial fluid between the patient with

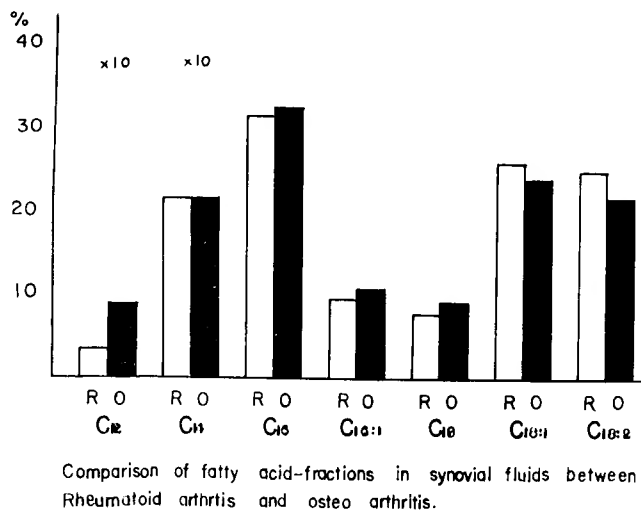


Fig. 1

Table 1. Each mean was obtained from 30 determinations in 11 cases of rheumatoid arthritis (R. A.) and 25 determinations in 18 patients of osteoarthritis (O. A.).

Fatty acid	Lauric C ₁₂	Myristic C ₁₄	Palmitic C ₁₆	Palmitoleic C _{16:1}	Stearic C ₁₈	Oleic C _{18:1}	Linoleic C _{18:2}
R. A.	0.32	2.17	30.72	9.24	7.77	25.29	24.31
Mean S. D.	±0.21	±0.55	±0.81	±1.35	±1.74	±1.35	±1.77
O. A.	0.82	2.17	31.35	10.53	8.88	23.78	22.38
Mean S. D.	±0.34	±0.59	±1.49	±1.15	±1.21	±1.53	±1.21

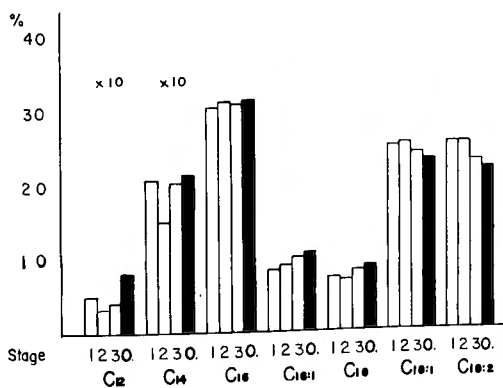


Fig. 2

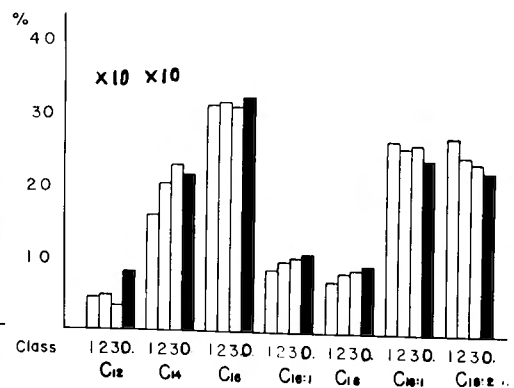


Fig. 3

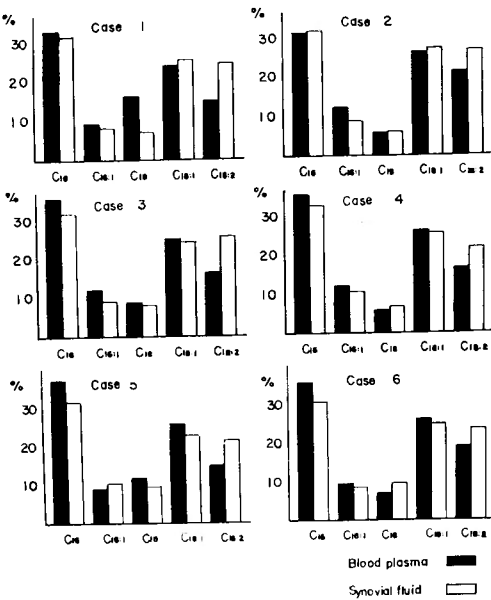


Fig. 4

Table 2. Comparison of fatty acid-fraction between synovial fluids and blood plasma in same subject.

Case		C12	C14	C16	C16:1	C18	C18:1	C18:2
(1)	Plasma	0.38	3.77	32.39	9.04	16.20	23.72	14.50
	Fluid (L)	0.26	1.88	31.95	8.78	7.03	25.48	24.68
	(R)	0.26	1.38	31.09	8.00	6.74	26.68	25.91
(2)	Plasma	0.22	2.05	31.27	12.51	5.69	26.49	21.77
	Fluid (L)	0.13	1.65	31.77	7.37	5.72	27.31	26.05
	(R)	0.28	1.87	30.88	9.14	7.46	26.87	23.50
(3)	Plasma	0.20	1.90	35.52	12.20	7.80	25.10	16.23
	Fluid (L)	0.33	1.87	32.68	8.17	7.54	23.93	25.45
	(R)	1.00	2.00	32.87	8.76	8.37	23.12	23.90
(4)	Plasma	0.17	3.22	35.52	12.40	5.79	26.98	16.54
	Fluid	0.28	2.23	32.06	10.32	6.86	26.71	21.55
(5)	Plasma	0.82	1.42	37.76	7.76	11.43	25.71	15.10
	Fluid	1.32	3.29	31.58	10.53	9.21	22.37	21.70
(6)	Plasma	0.18	3.21	35.12	9.51	6.69	26.46	18.54
	Fluid	0.61	1.83	30.49	8.54	9.76	25.61	23.17

rheumatoid arthritis and osteoarthritis :

The rates of fatty acid fraction in the rheumatoid arthritis were found to be low in the short chain side of stearic acid, whereas the rates were found to be low in the long chain side in case of osteoarthritis.

2) Relationship according to STEINBROCKER's classification between rheumatoid arthritis and fatty acid fraction in the synovial fluid :

The rate of fraction in the rheumatoid arthritis showed a tendency to approach that of the osteoarthritis with development of stage and class.

3) Comparison of fatty acid fraction between synovial fluid and blood plasma in same subjects :

Linoleic acid fraction in the synovial fluid of all cases with either rheumatoid arthritis or osteoarthritis was found to be increased noticeably, but palmitic fraction showed a tendency of somewhat decreasing as compared with that in the blood plasma.

4) No significant difference of fatty acid fraction in the synovial fluid was found between right and left side in the same subjects.

DISCUSSION

Since biochemical studies on the synovial fluid in the patient with rheumatoid arthritis and osteoarthritis are important to determine diagnosis and prognosis of the disease, they have been made in detail.

Inasmuch as the neutral fat and phospholipid were known to be synthesized in the cell of the synovial membrane, orthopedic surgery has become interested recently in fatty acid metabolism in the synovial fluid.

BUCHMAN & MARKS¹⁾⁴⁾ reported that leucocytes play an important role for the lipid synthesis, and BOLLE²⁾ described that lipid contents in the synovial fluid of the rheumatoid arthritis are increased. These reports indicate that inflammatory change of synovial membrane is one of the important factors influencing the lipid metabolism in the synovial fluid.

ROPE and BAUER⁵⁾ reported that trace amounts of phospholipid and cholesterol existed in the normal synovial fluid, and phospholipid, cholesterol and neutral fat were increased in the synovial fluid of rheumatoid arthritis. They also described that the accumulation of lipid in the articular cavity is due to excess destruction of the tissue and stimulation of rice bodies which were derived from inflammatory changes of articular cavity causing the increment of lipid substances in the synovial fluid.

SCHMID, MACNAIR and FUJIWARA⁶⁾⁷⁾⁸⁾¹⁰⁾ reported that the existence of α_1 and β_1 lipoprotein was confirmed in the synovial fluid of the patients with traumatic arthritis, rheumatoid arthritis and of postmortem without joint disease. SMALL⁹⁾ reported that after ultracentrifugation the lipoprotein content in the synovial fluid was found to be 40% less than that in the blood, and lipoprotein content in the synovial fluids was related with either inflammatory change or non-inflammatory change in the synovial fluid. CHUNG³⁾ described that small amounts of lipid are synthesized in the cell of the synovial membrane in rheumatoid arthritis and osteoarthritis. The results obtained in the present study indicate that there is original metabolism in the synovial membrane independent of lipid of the blood, and they are in agreement with the findings mentioned above.

On the other hand, some authors reported that lipid such as phospholipid in the normal synovial fluid shows a similar composition with that in the serum. These results mean that lipid in the synovial fluid is a filtrate from blood through synovial membrane.

The rate of fatty acid fraction in the synovial fluid in the patients with rheumatoid arthritis showed a tendency to approach that in the patients of osteoarthritis in proportion to development of stage and class. These results suggest that changes of lipid metabolism in the synovial fluid are caused by shift of inflammation from acute to stable stage in the patients of rheumatoid arthritis.

Furthermore, it has been confirmed that inflammatory change of synovial membrane is to be a influential factor of the fatty acid metabolism in the synovial fluid.

The results of this study seem to indicate that the variation of fatty acid metabolism in the synovial fluid should be considered to be one part of the disturbances of various kinds of metabolism resulting from histological changes in joint such as deformation of the bone, thickening of the synovial membrane and ankylosis.

CONCLUSION

The rate of the fatty acid fraction was found to be increased in the long chain side of stearic acid in the rheumatoid arthritis, whereas it was found to be increased in the short chain side in case of osteoarthritis.

Changes of the fatty acid fractions were found to be related closely with the course of inflammation because the rates of fatty acid fraction of the rheumatoid arthritis are getting similar with those of osteoarthritis in proportion to the development of stage and class of the rheumatoid arthritis.

The rates of fatty acid fraction of the synovial fluid and plasma in the same subjects were found to be different.

These results indicate that there is fatty acid metabolism in the synovial fluid having no relation with that of blood and being independent of permeability of articular membrane.

No significant relation was found between fatty acid fractions in the synovial fluid of right and left side in the same subjects.

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和文抄録

慢性関節リウマチならびに変形性関節症の 関節液脂酸代謝に関する研究

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小 野 繁

慢性関節リウマチ（リウマチと略す）と変形性関節症とはその病因、病勢、予後等に関し常に対比され研究されている代表的関節疾患である。両疾患の本態解明に対し炎症性、非炎症性の概念を基本として代謝の変動は生化学的に広汎に研究されているが病期や病勢に伴う特有な物質代謝の意義については明確でない。両疾患の関節液における代謝の特異性は両疾患は個々に独立した局所疾患というよりむしろ全身疾患の一部分現象として解釈すべきものであることを示している。このような観点から我々はリウマチおよび変形性関節症における関節液ならびに血液の構成脂酸分画について検討した。分析試料としての関節液は11人のリウマチ患者30検体と18人の変形性関節症患者25検体につき採取した。一部の症例では同時に血漿についても分析し関節液の分画と比較し、また左右の膝関節より同時に採取し、左右関節液構成脂酸比の差異も検討した。膝関節穿刺により採取した関節液脂質は Folch 法により抽出し Methyl ester 化し、柳本・GCG・3D型 Gaschromatography で分画し百分率は半値中法を応用して求めた。

1) リウマチならびに変形性関節症の関節液脂酸分

画の変動について：

C¹⁸-Stearin 酸を境としてリウマチで短鎖側で若干の低値を示すのに反し長鎖側の分画比は変形性関節症の方が低値を示した。

2) リウマチの Steinbrocker の分類と関節液能節分画との関連性について：

Steinbrocker の分類にしたがつてリウマチを Stage, Class 別に分類し関節液構成脂酸を 変形性関節症と比較した結果 Stage および Class が進むにつれて脂酸分画は変形性関節症の値に近づく傾向を認めた。

3) 同一症例における血漿、関節液ならびに左右の関節液構成脂酸の比較について：

関節液の構成成分からみると関節液は血液の透過物であるとの一般的な概念があるので両者における構成脂酸の関連性について検討した結果関節液では明らかに血漿脂酸分画と比較し全症例の C₁₈:2 Linol 酸分画の増加を認めたが C₁₆ Palmitin 酸分画では多少減少の傾向を示したことから関節液における脂酸代謝は関節膜の透過性に関係なく血液に由来しない独自のものがあることを認めた。また同一症例における左右の関節液構成脂酸分画では有意の差は認めなかつた。